



Space Weather Research in Ukraine

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Outline

- Funding of SW research in Ukraine
- Key SW research institutions
- The Sun and the solar wind
- The magnetosphere
- The ionosphere and the neutral atmosphere
- Space weather forecasting
- Instrumentation
- Spacecraft Weather Missions
- International cooperation

Funding of SW research in Ukraine

- National Academy of Sciences of Ukraine
 - General R&D expenditure (base funding)
 - General research grants
 - Program GEO-UA (2008-2010)
- National Space Agency of Ukraine
 - Project Potential (experiment onboard EOS)
 - Project Ionosat (ionospheric spacecraft cluster)
- Other governmental bodies
 - General research grants

Key SW research institutions



Space Research Institute <http://www.ikd.kiev.ua/>

– Space Plasma Department <http://plasma.ikd.kiev.ua/>

– L'viv Center <http://www.isr.lviv.ua/>



Main Astronomical Observatory <http://mao.kiev.ua/>



Kyiv National University <http://univ.kiev.ua/>

– Astronomical Observatory <http://www.observ.univ.kiev.ua/>

– Chairs of Astronomy and Space Physics <http://space.univ.kiev.ua/>



Radioastronomical Institute <http://ri.kharkov.ua/>



Institute of the Ionosphere
<http://www.kpi.kharkiv.edu/iion/>



Kharkiv National University <http://univer.kharkov.ua/>

– Faculty of Radiophysics <http://www-radiophys.univer.kharkov.ua/>



Crimean Astrophysical Observatory
<http://www.crao.crimea.ua/>

The Sun and the solar wind

- Spherical Taylor-Couette flow dynamo
- Spectrometry of the Sun
- Local helioseismology of sunspots
- Modelling of pre-flare state in active regions
- Modelling of large-scale coronal structures
- Modelling of circular CMEs (“smoke rings”)
- Investigation of solar climate forcing

The magnetosphere

- Theoretical and experimental study of ULF MHD perturbations in the magnetosphere
- Modelling of energy transport from the magnetopause to the inner magnetosphere
- Theoretical investigation of substorm events
- Theoretical and experimental study of wave-particle interactions in the magnetosphere
- Theoretical and experimental study of the magnetospheric turbulence

The ionosphere and the neutral atmosphere

- Active experiments with acoustic excitation
- Recovery of global lightning activity
- Study of sprites, elves and jets
- Modelling of atmospheric gravity waves
- Study of lithosphere-ionosphere connection
- Study of troposphere-ionosphere connection
- Study of seismogenic AGWs and TIDs
- Detection of ionospheric signatures of powerful energy release events

Space weather forecasting

- Forecasting D_{ST} , a_p and K_p at least 3 hours ahead with high accuracy (PE ~ 80%)
- Fast operation (< 10 s on an average PC)
- New knowledge about underlying physics
- Forecasting A_p and $F_{10.7}$ at least 1 day ahead
- An operational forecast tool is under development

Instrumentation

- Flux-gate and induction magnetometers
 - Super low weight, low power, high reliability
- Electric field sensor
 - World's first direct measurements of spatial current density
- Particle detectors
 - Measurement of both charged and neutral particles; live testing of radioactive load on electronic equipment

Instrumentation

- Ground-based equipment
 - RT-70 – a 70-meter fully rotational transmitting radiotelescope, primary wavelength 6 cm
 - UTR-2 – a decameter radiotelescope
 - URAN – a VLBI network (4+1 segments)
 - A partial reflections radar
 - A 100-meter incoherent scatter radar
 - An ionospheric heating facility
 - A mobile acoustic ionospheric excitation unit
 - An INTERMAGNET magnetic observatory

Space Weather Missions before 1992

- Cosmos-484 – 1972 (E. field measurements)
- Intercosmos-10 – 1973 (as above)
- Cosmos-721 – 1975 (as above)
- Prognoz-8 – 1981 (magnetospheric waves)
- Mars-6 – 1984 (E. field and plasma waves)
- Venus-Halley – 1984 (plasma waves)
- Intershock-Prognoz – 1985 (foreshock waves)
- Phobos-1,-2 – 1988 (interplanetary EM waves)
- CRESS – 1991 (injection of barium clouds)
- Intercosmos-25 APEX – 1991 (injection of electron and plasma beams)

Space Weather Missions after 1992

- Coronas-I (RU) – 1994 (solar physics)
- Interball (RU) – 2000 (magnetospheric waves)
- Coronas-F (RU) – 2001 (solar physics)
- Variant (UA) – 2004 (ionospheric waves)
- Compass (RU) – 2005 (ionosphere)
- Coronas-Photon (RU) – 2009 (solar physics)
- Potential (UA) – 2010 (neutrals density measurements)
- Environment (UA) – TBD (ISS impact on plasma)
- Chibis (RU) – TBD (lightning, plasma physics)
- Phobos-Ground (RU) – TBD (space plasma physics)
- Resonance (RU) – 2014 (magnetospheric waves, 4 SC)
- Ionosat (UA) – TBD (ionospheric waves, 3 SC)

International cooperation

- FP7 <http://ec.europa.eu/research/fp7/>:
 - AFFECTS (SRI NASU & NSAU)
 - POPDAT (SRI NASU & NSAU with L'viv Center)
- JRC <http://ec.europa.eu/dgs/jrc/>
- STCU <http://www.stcu.int/>
- CRDF <http://www.crdf.org/>
- SFFR <http://www.dffd.gov.ua/>
- NASU <http://www.nas.gov.ua/>
- NSAU <http://www.nkau.gov.ua/>
- Direct collaboration

Thank you for your kind attention!



We look forward to fruitful cooperation!